

HUBNET: Wide Area Network Utilization of Local Area Network Medical Reference and Communication Resources

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The State University of New York at Buffalo School of Medicine and Biomedical Sciences and its associated teaching sites have developed and partially implemented a regional Wide Area Network (WAN) in Buffalo and Western New York. The school wishes to use this WAN to deliver reference and communication resources to students, residents and faculty. The richest pool of easy to use reference and communication resources are PC software programs that are intended for individual workstations or at best, client - server, Local Area Network (LAN) implementation. HUBNET (Hospitals and University at Buffalo Library Resource Network), a project of the School of Medicine and the Library Consortium of Health Institutions in Buffalo offers integrated presentation of many such LAN resources over this regional WAN. The system crosses many institutional boundaries and reaches physically remote sites in a complex mix of information systems environments with few issues related to performance. The system design provides a level of ease of use that has brought many new users into active computer use while addressing integration into diverse information systems settings and networking environments.

INTRODUCTION

The School of Medicine and Biomedical Sciences of the State University of New York at Buffalo has eight teaching hospitals that are distributed throughout the city of Buffalo and Western New York. This geographic distribution and an increasing emphasis on primary care put significant demands on the school's ability to communicate with and support its students, residents and faculty at the clinical sites in which they work. Electronic resources, especially those that can be offered through a consistent and easy to use interface, can potentially enhance communication across this

wide area and allow remote access to many of the support resources of the medical school and university. The geographic distribution of the medical school is complicated by a wide variety of information systems and network environments making the task of consistent and distributed presentation of materials difficult. These different systems complicate the school's ability to offer more than simply the lowest common denominator of electronic resources. Through the Western New York Health Sciences Consortium, an alliance of the teaching hospitals and the School of Medicine, a city-wide FDDI ring has been established. The medical school and four of the eight teaching hospitals have contracted for FDDI service with the provider NYNEX for multi-year connectivity to a city wide FDDI ring. Two other teaching hospitals have ethernet level connections with the medical school via microwave and fiber optic media, and several other associated hospitals and primary care sites have developed T1 level connection to this FDDI ring.

HUBNET is a reference and communication system which resides at the School of Medicine and Biomedical Sciences and is offered as a subscription service across the FDDI / T1 WAN. The impetus for the HUBNET system arose from discontent with the existing environment which included a university MiniMedline system, single-workstation CD-Plus Medline systems installed in several hospitals and hospitals and individuals using on-line fee based Medline access. Many of the hospitals in the consortium were facing increased Medline costs as they moved from single Medline workstations in their libraries to many networked access points. The hospitals and the university were also facing increasing costs and the need for greater technical expertise to mount and support the increasing number of on-line resources becoming available. In addition, there was also a desire to make the resources at the

different clinical sites consistent, so that students, faculty and staff would not have to learn new systems as they moved from site to site. This is especially important because of the shared undergraduate and graduate training programs that exist in this consortium environment.

PLATFORM CHOICES

While investigating the different possibilities for presenting the Medline database, it became clear to the HUBNET committee that the most attractive interface, based on ease of use and search capabilities, was the Microsoft Windows CD-Plus search engine. While some users may find fault with specifics of the search engine and some may desire wholly different access software, few can argue that the software domain defined by Microsoft Windows and the DOS applications that can be run within Windows offer the largest pool of easy to use electronic reference resources. Additional resources were important as the HUBNET committee also wanted to create as rich a support environment as possible. The HUBNET committee noted that a Windows or Windows compatible workstation was the defacto standard for workstations in the associated hospital libraries and at hospital clinical sites and therefore decided to offer Microsoft Windows CD-Plus Medline. However, the committee did not want to exclude existing Macintosh and Unix workstations completely. Also, quality dial-in access and easy installation of the networked offering in the diverse environments of the networked sites were desirable. Finally all of this needed to be delivered in an environment with constrained resources, limited technical support and many political and technical hurdles.

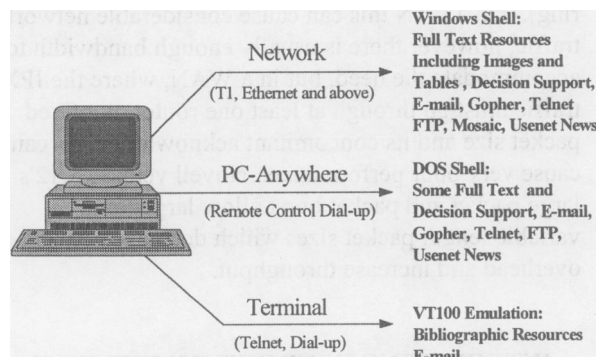


Figure 1: HUBNET Access Methods and Available Resources

In order to meet the diverse needs of this environment three methods of HUBNET access were developed, with differing amounts of resources available via each of the access methods. The resources available in each method are constrained by the technical possibilities of that method. Generally, the number of resources available is inversely proportional to the variety of computer platforms that can access the system using that method.

"NETWORKED" HUBNET ACCESS

The full range of HUBNET resources is available via direct access to a series of four Novell file servers that comprise "Networked" HUBNET.

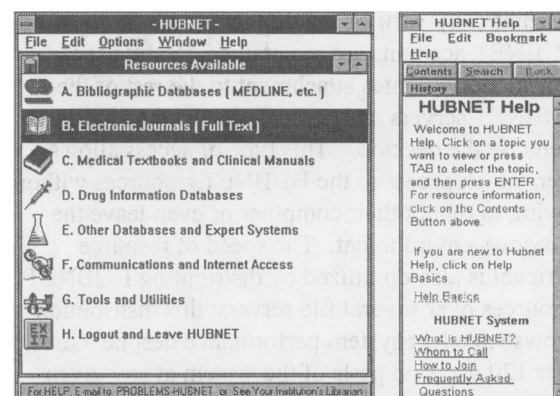


Figure 2: "Networked" HUBNET Interface

This HUBNET presentation is available to any Microsoft Windows capable computer that has a direct network connection to the WAN, allowing access to the following resources:

- full Medline database (1966 to present)
- Cinahl
- CancerLit
- Health
- Current Contents
- 19 full text electronic journals (NEJM, JAMA, Annals of Internal Medicine, etc.)
- six textbooks of medicine (Scientific American Consult, Merck manual, etc.)
- two drug information databases
- two expert systems,
- electronic mail and scheduling software
- Gopher, Mosaic and a Usenet News reader
- menued telnet and ftp

There is also an on-line account application program which allows guest users to request a full HUBNET account. These resources are offered in a graphical menu system which has on-line HUBNET help describing where information is available and how to get started with a specific program in addition to the help systems of the individual applications.

"Networked" HUBNET access is achieved by IPX Ethernet II connection to one HUBNET Novell server. This connection is made by running a Novell workstation shell, enabling Novell support in Windows and a single drive mapping, which enables a Windows (or OS/2) computer on the WAN to put a HUBNET Icon on their local desktop. When the user clicks on the HUBNET icon, username and password dialog boxes are presented and user input is automatically verified on another Novell server where HUBNET accounts are maintained. Valid user information initiates attachment to the rest of the HUBNET servers and presentation of the HUBNET menu on the desktop. This type of access allows users quick access to the HUBNET resources without having to reboot their computer or even leave the Windows environment. The speed of resource retrieval is also optimized by distributing HUBNET resources over several file servers; this distribution allows excellent system performance despite a load of over 120 users on parts of the system at any given time.

IPX on the WAN

"Networked" HUBNET access uses the IPX Ethernet II networking protocol native to Novell file services. Offering IPX file services out to a complex WAN environment was a major issue in the development of HUBNET. The initial commitment of the WAN networking committee was to support only TCP/IP communications as in the Internet and other complex networking environments. Unlike TCP/IP networking schemes where "firewalls" can be readily constructed, incorrectly configured IPX network servers can cause considerable problems for other IPX network servers. In addition Novell servers learn about and advertise information about other network resources. Network managers at the university and at the clinical sites were wary of these institutional resources being advertised across institutional boundaries.

The solution to the firewall issue was to set up a dedicated ethernet network on the university's

Wellfleet router on which the HUBNET servers would be located. This network was configured so that it did not receive advertisements of file services from other networks (Server Advertisement Protocol - "SAP" is turned off to this network). Accordingly, the servers on this special network do not "know" about other file services and therefore cannot advertise these services to others. There are several additional filters in place where the university router is attached to the FDDI ring. The university router drops all outgoing IPX SAP traffic except for the file services from the HUBNET Novell servers (this is basically a static SAP table). This filter stops any additional university servers from being advertised to the hospitals. The university router drops all incoming packets destined for socket 0x0452. This filter prevents any incoming SAP from the hospitals. The University also drops incoming traffic destined for socket 0x0456 (the diagnostic socket) which was implemented to cure a stalling problem that developed university-wide due to an interaction of Arcserve's client software NLM (at a hospital) with the Clarkson packet driver version of Novell access shell. The clients would experience what looked like a stall in server access which was actually an endless string of Routing Information Protocol (RIP) requests. The software was trying to seek out clients to back-up.

The diagnostic socket issue is avoided if clients are running ODI instead of "packet driver" Novell shells. ODI is very desirable on clients because it also enables much better IPX WAN performance through the use of Novell's large packet and packet burst protocols. IPX in WAN environments has been inhibited in the past because each packet sent requires an acknowledgment and each packet could only be 512 bytes large (1/3rd of ethernet and 1/9th of token ring). On a LAN this can cause considerable network traffic, however there is usually enough bandwidth to accommodate the need, but in a WAN, where the IPX traffic must go through at least one router, the fixed packet size and its concomitant acknowledgment can cause very poor performance. Novell version 3.12's large packet and packet burst allow larger and variable length packet sizes which decrease network overhead and increase throughput.

INTEGRATING WINDOWS ON THE WAN

One of the design goals of the HUBNET system was to position it on a "clinical desktop" along with terminal access windows to hospital information

systems applications and other programs. Work done by ourselves [1,2] and others [3] describes methods for directing the user through coordinated Windows on a desktop and associating reference materials with the content and context of other work on a clinical desktop. To achieve this type of parallel positioning, the HUBNET system needed to be a Microsoft Windows application itself with the ability to check user authenticity, attach to Novell file services and map network drives from within Windows. We did not want users to have multiple login procedures or are required to exit and restart Windows (with its associated time delay) in order to gain network access. Additionally, we needed a system that could easily accept software updates and the changes that they frequently involve, and which would allow the addition of new software with minimal restructuring. We achieved these goals by using a combination of Winbatch software for Windows (Wilson Windoware) and a Windows menu program (Saber menu for Windows - Saber Software Corporation).

We first use Winbach to authenticate the user against the bindery of one Novell server, then to connect to other file servers and map network drives within the Windows environment. We also use Winbatch to check local tag files which are copied into the Windows and system directories of local PC's or networked Windows installations. These tag files list the current versions of executable files and .dll files that are copied to local or locally networked Windows directories. These files are moved to a local installation because some poorly designed software demands that certain files must be in specific places and to improve WAN performance in some circumstances by accessing local vs. remote files.

The final result step in the compiled Winbatch program is the execution of the Windows menu. The menuing program allows easy configuration of the individual software programs that make up the HUBNET system. Through the menu, software can also be offered selectively to users on the basis of membership in groups on the authentication server.

REMOTE DIAL-IN ACCESS

Even with the development of a regional WAN, good dial-in access is important for users at home and for users at sites which do not have enough computers to justify a T1 link. Dial-in is possible through the university dial string; users are attached to a terminal

server and can attach to HUBNET via the VT100 emulation that is described below. Better dial-in access, however, is offered through PC-Anywhere remote software and a series of PC's on HUBNET's own dial string. Incoming calls are automatically forwarded to the next open line by the phone system. An available phone line connects the user to a PC running PC-Anywhere host for DOS software. This dial-in access was first offered to hospital libraries that did not have network connections, but proved to be very popular among PC users who could get mouse control and bounce bar, menued access to DOS applications on the HUBNET system. Many of the HUBNET Windows resources (Citation databases, full text journals, some textbooks, e-mail, Gopher, Telnet, FTP, Usenet News, etc.) have DOS analogs that access the same data or Internet resources. Many Macintosh users have found that they too can access these resources, despite the lack of a Macintosh shell and the poor WAN capabilities of Appletalk, by running SoftPC and PC-Anywhere in combination. This solution certainly does not maintain the Macintosh interface and some Macintosh users find it to be unacceptable on older, slower machines.

TCP/IP ACCESS FOR DOS APPLICATIONS

Retaining access for other operating systems in the university and hospital environments was an important consideration. Limited resources and technical staff made it desirable to offer TCP/IP telnet access to networked, non-Windows computers and to computers that could not run PC-Anywhere. VT100 terminal access to DOS applications was realized by using a Xyplex terminal server placed on the ethernet network with 10 serially attached personal computers connected to the HUBNET Novell file servers via IPX. The terminal server has a rotary configured on it which allows clients connecting by telnet to find the next available PC. Once connected to a PC through the terminal server the user controls the PC via VT100 keystrokes and can run the citation databases and e-mail programs. Users can download search sets via ftp or kermit directly to their PC in this configuration.

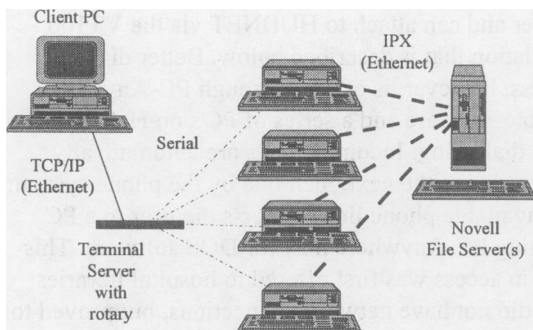


Figure 3: DOS Applications via VT100

SYSTEM USAGE

HUBNET has met the needs of its participating institutions by providing easy to use, networked access to citation databases across a WAN. The system has exceeded many expectations by offering more full text and Internet resources than had been anticipated by virtue of the savings generated through shared access and by virtue of the ease with which LAN resources can be installed and updated. In the eight months that HUBNET has been fully functional 3,800 user accounts have been established on the system. Anecdotally, many of these users are new to electronic reference and communications and many others are using resources in new ways (printing out articles for rounds, calling up information on the spot to answer patient care questions, signing out via e-mail). While full usage statistics will be available for presentation with this paper in November, it is already clear that the communications and full text resources of the system are being used much more heavily than was first expected and that the consistent interface implementation and help systems have expanded the number of programs users are comfortable using frequently.

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